Lesson 13.1.1

13-5. a: always, b: never, c: always, d: true for $x = \frac{\pi}{4} + 2\pi n$ and $x = \frac{5\pi}{4} + 2\pi n$

13-6. a: $(x-2)(x+2)$, b: $(y-9)(y+9)$, c: $(1-x)(1+x)$, d: $(1-\sin x)(1+\sin x)$

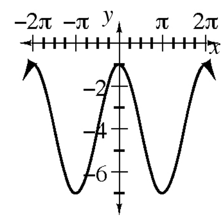
13-7. a: ≈ 80.86; b: ≈ 24.05; c: $\approx 15.50^\circ$; possible methods: trigonometric ratios, Law of Sines, Law of Cosines, Pythagorean Theorem

13-8. The graphs of $y = \cos(2x)$ and $y = 2\cos(x)$ have different amplitudes and periods.

13-9. a: $x \geq 2$, $f(x) \geq 2$; b: $f^{-1}(x) = \frac{(x-2)^2}{2} + 2$; c: $x \geq 2$, $f^{-1}(x) \geq 2$

13-10. a: stretched (amplitude = 3), shifted left $\frac{\pi}{2}$, and shifted down 4

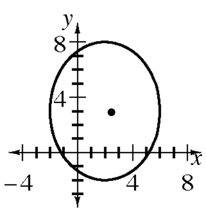
b:



13-11. 610

13-12. a: 12, b: $\frac{1}{2}$

13-13.



a: (2, –2), (2, 8), (–2, 3), and (6, 3)

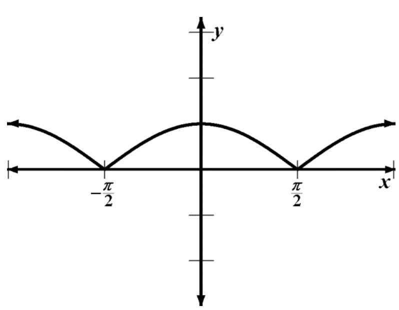
13-14. a: ${}_{12}P_5 = 95{,}040$, b: ${}_{12}C_5 = 792$

13-15. sample answers: $h = \frac{\pi}{2}, \frac{5\pi}{2}, -\frac{3\pi}{2}$

13-16. a: negative, b: negative, c: positive, d: negative

13-17. $a \leq \frac{25}{24}$

13-18.

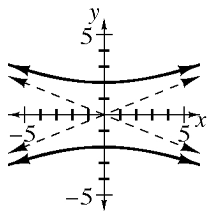


13-19. $\frac{5}{x+4}$

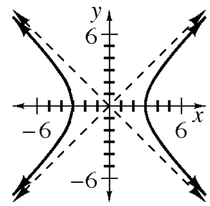
13-20. a: 9, b: –9

13-21. a: $\frac{3\pi}{5}$, b: $\frac{16\pi}{9}$, c: 140°, d: 285°, e: 1530°, f: $\frac{13\pi}{9}$

13-22. a: $(0, \pm 2)$, $y = \pm \frac{2}{5}x$, up/down



b: $(\pm 3, 0)$, $y = \pm x$, left/right



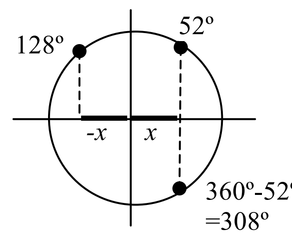
13-23. a: $\frac{{}_5C_2 \cdot {}_4C_1}{{}_{12}C_5} = \frac{2}{11}$, b: $\frac{{}_4C_3}{{}_{12}C_3} = \frac{1}{55}$, c: $\frac{{}_5C_1 \cdot {}_4C_1 \cdot {}_3C_1}{{}_{12}C_3} = \frac{3}{11}$, d: $\frac{{}_5C_3 + {}_4C_3 + {}_3C_3}{{}_{12}C_3} = \frac{3}{44}$, e: $\frac{{}_5C_1 \cdot {}_4C_2}{{}_{12}C_3} = \frac{3}{22}$,
f: $1 - (\frac{3}{11} + \frac{3}{44})$

13-24. a: $a^3 + 3a^2b + 3ab^2 + b^3$, b: $8m^3 + 60m^2 + 150m + 125$

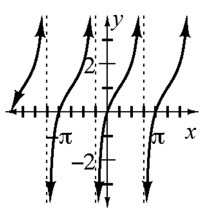
Lesson 13.1.2

13-31. a: $\frac{\pi}{6}, \frac{5\pi}{6}$; b: $\frac{5\pi}{6}, \frac{7\pi}{6}$; c: $\frac{\pi}{4}, \frac{3\pi}{4}$; d: $0, 2\pi$

13-32. No, 52° and 308° have the same value for the cosine, while 128° has the exact opposite cosine value. Diagram at right.



13-33.



13-34. $f^{-1}(x) = -x + 6$

13-35. $\frac{x}{x+2}$

13-36. a: yes; b: $x^4 + x^3 + x^2 + x + 1$, yes; c: $x^n + x^{n-1} + x^{n-2} + \ldots + x + 1$

13-37. ${}_{28}C_4 = 20{,}475$

13-38. a: $\frac{24}{91}$, b: $\frac{20}{91}$

13-39. a: 51, b: 64.77

13-40. a: $\frac{(x+2)^2}{16} + \frac{(y-1)^2}{4} = 1$, b: $\frac{(x-3)^2}{9} + \frac{(y-2)^2}{16} = 1$

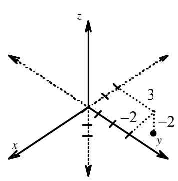
Lesson 13.1.3

13-46. **a:** $30°, 150°$ or $\frac{\pi}{6}, \frac{5\pi}{6}$; **b:** $120°, 240°$ or $\frac{2\pi}{3}, \frac{4\pi}{3}$; **c:** $45°, 225°$ or $\frac{\pi}{4}, \frac{5\pi}{4}$;
d: $\approx 35.26°, 144.74°, 215.26°, 324.74°$ or $0.62, 2.19, 3.76, 6.08$

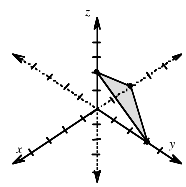
13-47. **a:** domain: $-3 \le x \le 3$, range: $-3 \le y \le 3$, no;
b: domain: $-3 \le x \le 4$, range: $-2 \le y \le 4$, no;
c: domain: $x \le 3$, range: $y \le 4$, yes;
d: domain: $\infty < x < \infty$, range: $x \ge -2$, yes

13-48. **a:** 2, **b:** no solution

13-49. **a:**



b:



13-50. **a:** (4, 8), **b:** (0, –2, 3)

13-51. $2x^4 - 2x + 1 + \frac{-1}{x-3}$

13-52. $\frac{(x-1)^2}{25} + \frac{(y+5)^2}{144} = 1$

13-53. **a:** –344, **b:** –6740

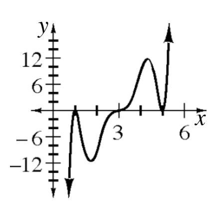
13-54. **a:** $\frac{32}{7}$; **b:** no sum, $r > 1$

13-55. The restrictions are needed so that the inverses will be functions. The domain of the sine function is restricted to $-\frac{\pi}{2} \le x \le \frac{\pi}{2}$, the domain of the cosine function is restricted to $0 \le x \le \pi$, and the domain of the tangent function is restricted to $-\frac{\pi}{2} < x < \frac{\pi}{2}$.

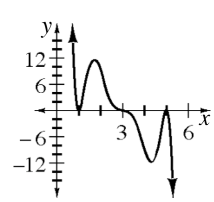
13-56. **a:** $x = \frac{7\pi}{6} + 2\pi n, \frac{11\pi}{6} + 2\pi n$; **b:** $x = \frac{\pi}{6} + 2\pi n, \frac{11\pi}{6} + 2\pi n$; **c:** $x = \frac{3\pi}{4} + \pi n$; **d:** $x = \pi n$

13-57. **a:** shifted up 1 unit, **b:** shifted left $\frac{\pi}{4}$, **c:** flipped,
d: vertically stretched by a factor of 4

13-58. **a:**



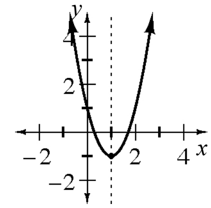
b:



c: $g(x) = -f(x)$

13-59. **a:** $\frac{3+2}{6} = \frac{5}{6}$, **b:** $\frac{3x+8}{2x^2}$, **c:** $\frac{x^2+2x+3}{(x+1)(x-1)}$ or $\frac{x^2+2x+3}{x^2-1}$, **d:** $\frac{\sin^2\theta + \cos\theta}{\sin\theta\cos\theta}$

13-60. $f(x)=2(x-1)^2-1$; domain: all real numbers, range: $f(x)\geq -1$, vertex: $(1,-1)$, line of symmetry: $x=1$



13-61. a: 1.356, b: 2.112, c: 1.792

13-62. a: $a^4+4a^3b+6a^2b^2+4ab^3+b^4$, b: $81m^4-216m^3+216m^2-96m+16$

13-63. ${}_{100}C_3=161{,}700$

Lesson 13.1.4

13-70. a: $\frac{a}{c}$, b: $\frac{c}{b}$, c: $\frac{c}{b}$, d: $\frac{b}{a}$

13-71. a: $\pm\frac{\pi}{6}, \pm\frac{5\pi}{6}, \pm\frac{7\pi}{6}, \pm\frac{11\pi}{6}$; b: same as part (a)

13-72. 90°, 270°, 210°, 330° or $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$

13-73. 9.10

13-74. 1.083, 8.3%

13-75. a: a^3+b^3, b: x^3-8, c: y^3+125, d: x^3-y^3,
e: They consist only of two terms: sum or difference of cubes.

13-76. a: $(x+y)(x^2-xy+y^2)$, b: $(x-3)(x^2+3x+9)$, c: $(2x-y)(4x^2+y^2)$,
d: $(x+1)(x^2-x+1)$

13-77. $y=\frac{10}{216}(x+6)^3-10$

13-78. a: hyperbola, center (0, –1), vertices (±4, –1), asymptote at $y=\frac{3}{4}x-1$
b: parabola (sleeping), vertex (2, 1)
c: circle, center (3, 0), radius 5

13-79. $\frac{y^2}{25}-\frac{x^2}{6.25}=1$

13-80. a: $\frac{{}_3C_1\cdot{}_{10}C_3}{{}_{13}C_4}=\frac{360}{715}\approx 0.503$, b: $\frac{11}{{}_{13}C_4}=\frac{1}{65}=0.015$

13-81. a: $\frac{c}{a}$, b: $\frac{a}{b}$, c: $\frac{b}{a}$, d: $\frac{c}{a}$

13-82. 90°, 270°, 210°, 330° or $\frac{\pi}{2}, \frac{3\pi}{2}, \frac{7\pi}{6}, \frac{11\pi}{6}$

13-83. $2x^2+4x-1$

13-84. a: 2, b: $\frac{3}{4}$

13-85. a: $x^2(x+2y)(x^2-2xy+4y^2)$, b: $(2y^2-5x)(4y^4+10xy^2+25x^2)$,
c: $(x+y)(x-y)(x^2-xy+y^2)(x^2+xy-y^2)$

13-86. Most students will assume it is a cubic with $y=x^3$ as the parent, though other options are also reasonable. An equation of the graph is $y=\frac{1}{8}(x-3)^3+3$; its inverse is $y=\sqrt[3]{8(x-3)}+3$.

13-87. $y=4(0.4)^x+5$

13-88. a: $126a^5b^4$, b: $1120x^4y^4$

13-89. P(3 or 4 or 5) $\approx$ 0.99

Lesson 13.2.1

13-95. a: 1, b: $\cos(4w)$, c: $\tan(\theta)$

13-96. $\approx$ 75.52°, 75.52°, and 28.96°

13-97. a: $x=30^\circ+360^\circ n$ or $x=150^\circ+360^\circ n$, b: no solution

13-98. $3x^2-x+2$

13-99. x^3-2x^2-3x+9

13-100. a: $P=44$, $A=20$; b: $y=3+20\cos(\frac{\pi}{22}(x-15))$ is one possibility.

13-101. $\frac{(x-4)^2}{36}+\frac{(y+3)^2}{1}=1$

13-102. Possibilities may include: $\sin^2 x=1-\cos^2 x$, $\sin x=\pm\sqrt{1-\cos^2 x}$, $\sin^2 x=(1-\cos x)(1+\cos x)$, or similar variations for the cosine in terms of the sine.

13-103. $-\frac{4}{5}$

13-104. a: $\frac{\sin(\theta)}{\cos(\theta)}$, b: $\frac{1}{\sin(\theta)}$, c: $\frac{\cos(\theta)}{\sin(\theta)}$, d: $\frac{1}{\cos(\theta)}$

13-105. a: $y-9=\frac{315}{2}(x-2)$ or $y=\frac{315}{2}x-306$, b: $y=0.25(6)^x$

13-106. They intersect at $(\frac{1}{2}, 0)$ and $(3, 10)$.

13-107. a: $\frac{1}{2(x-1)}$, b: $\frac{4x}{3x^2+10x+3}$

13-108. a: $(0.9)^5\approx 0.59$, b: $10(0.9)^2(0.1)^3+5(0.9)(0.1)^4+(0.1)^5\approx 0.00856$

Lesson 13.2.2

13-110. 90.21 feet

13-111. a: $2x^4 - x^2 + 3x + 5 = (x-1)(2x^3 + 2x^2 + x + 4) + 9$,
b: $x^5 - 2x^3 + 1 = (x-3)(x^4 + 3x^3 + 7x^2 + 21x + 63) + 190$

13-112. a: $\frac{3\pi}{2}$; b: $\frac{\pi}{3}, \frac{5\pi}{3}$; c: $\frac{\pi}{4}, \frac{5\pi}{4}$; d: $\frac{7\pi}{6}, \frac{11\pi}{6}$

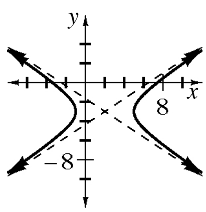
13-113. a: $\sin 34^\circ = \frac{x}{124}$, $x \approx 69.34'$; b: $x \approx 5.35$

13-114. a: $\frac{4}{36} = \frac{1}{9}$, b: $\frac{6}{36} = \frac{1}{6}$, c: $\frac{4}{10} = \frac{2}{5}$

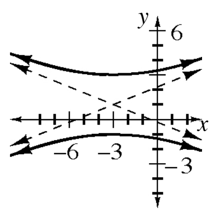
13-115. a: $\frac{2x+1}{3x-2}$, b: $\frac{x^2+2x+4}{x(4x+5)}$

13-116. a: 17, b: 5

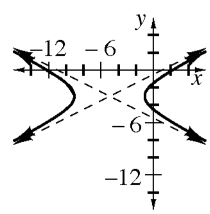
13-117. a:



b:

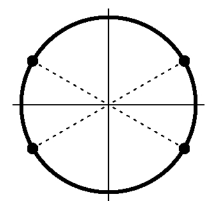


c:



13-118. Sample proofs:
a: $(\sin\theta + \cos\theta)^2 = \sin^2\theta + 2\sin\theta\cos\theta + \cos^2\theta = 1 + 2\sin\theta\cos\theta$,
b: $\tan\theta + \cot\theta = \frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta} = \frac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta} = \frac{1}{\sin\theta\cos\theta} = \csc\theta\sec\theta$,
c: $(\tan\theta\cos\theta)(\sin^2\theta + \frac{1}{\sec^2\theta}) = (\frac{\sin\theta}{\cos\theta}\cos\theta)(\sin^2\theta + \cos^2\theta) = \sin\theta$

13-119. unit circle shown at right; $\frac{\pi}{6}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{11\pi}{6}$



13-120. $m\angle B = 86.17^\circ$ or 1.5 radians

13-121. Most students will assume it is a parabola, though other families are also reasonable (it could also be a quartic, for example). The equation of the parabola is $y = \frac{1}{8}(x-3)^2 + 3$. It is a function; every input has only one output.

13-122. a: $x \approx 1.839$, b: $x \approx -1.839$, c: $x \approx 1.839$

13-123. a: The two lines intersect at $(8,17)$. b: No solution, because the lines are parallel.

13-124. possible answer: $f(x) = x^3 - 5x^2 + 8x - 6$

13-125. a: ellipse, $\frac{(x-1)^2}{9}+\frac{(y+3)^2}{18}=1$, center (1, –3), foci (1, 0) and (1, –6)

b: hyperbola, $\frac{(y+2)^2}{4}-\frac{x^2}{12}=1$, center (0, –2), foci (0, 2) and (0, –6), asymptotes $y=\pm\frac{\sqrt{3}}{3}x-2$

c: ellipse, $\frac{(x+2)^2}{8}+\frac{(y-3)^2}{12}=1$, center (–2, 3), foci (–2, 1) and (–2, 5)

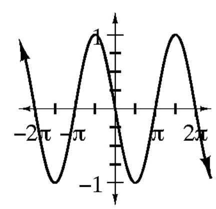
Lesson 13.2.3

13-129. $\sin\frac{\pi}{12}=\sin(\frac{\pi}{3}-\frac{\pi}{4})=\frac{\sqrt{6}-\sqrt{2}}{4}$; $\cos\frac{\pi}{12}=\cos(\frac{\pi}{3}-\frac{\pi}{4})=\frac{\sqrt{2}+\sqrt{6}}{4}$

13-130. a: $\sin(\frac{\pi}{3}+\frac{\pi}{4})=\frac{\sqrt{6}+\sqrt{2}}{4}$, b: $\cos(\frac{3\pi}{4}+\frac{\pi}{6})=\cos(\frac{7\pi}{6}-\frac{\pi}{4})=-\frac{\sqrt{6}+\sqrt{2}}{4}$

13-131. $\sin(x+x)=\sin x\cos x+\cos x\sin x=2\sin x\cos x$;
$\cos(x+x)=\cos x\cos x+\sin x\sin x=\cos^2 x+\sin^2 x$

13-132. a: See graph at right.
b: Possible answer: $f(x)=-\sin x$.
c: $\cos(x+\frac{\pi}{2})=\cos x\cos\frac{\pi}{2}-\sin x\sin\frac{\pi}{2}=-\sin x$
d: If students wrote $f(x)=-\sin x$ in part (b), the agreement is obvious. If not, they should recognize that they could have.



13-133. $\sin x+\cos x$

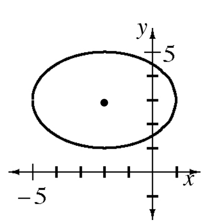
13-134. Divide by $x-3$, then solve the resulting quadratic; $x=1\pm i$.

13-135. a: –35, b: 123

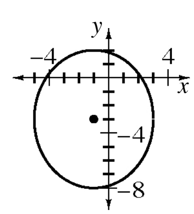
13-136. a: 2, b: $a-2$

13-137. $_3C_1(\frac{1}{4})^2(\frac{3}{4})=\frac{9}{64}$

13-138. a: center (–2, 3)
length 6 units
height 4 units



b: center (–1, –3)
length 8 units
height 10 units



c: center (5, 4)
length 6 units
height 4 units